CLAIMS

1. A process for producing two families of biofuels from at least one triglyceride, formed between at least one fatty acid and glycerol, characterized in that it comprises:

- at least one transesterification step in which said triglyceride is reacted by heterogeneous catalysis with at least one primary monoalcohol selected from methanol and ethanol to produce at least one methyl and/or ethyl ester of the fatty acids of the starting triglyceride(s) as the first biofuel, and glycerol, said products being free of by-products; and
- an etherification step in which the glycerol from the transesterification step is reacted directly (i.e. without prior chemical treatment) with at least one olefinic hydrocarbon containing 4 to 12 carbon atoms to obtain at least one glycerol acetal as the second biofuel; and/or
- an acetalization step in which the glycerol from the transesterification step is reacted directly, without prior chemical treatment, with at least one compound selected from aldehydes, ketones and acetals derived from aldehydes or ketones, to obtain at least one glycerol acetal as the second biofuel.

2. A process according to claim 1, characterized in that in the transesterification step, a solid catalyst is used selected from those comprising at least one oxide of at least one element selected from groups IIB, IVA and VB of the periodic table.

3. A process according to claim 2, characterized in that, in the transesterification step, a solid catalyst is used selected from those comprising:

- a mixture of at least aluminium oxide with at least one other oxide of at least one element selected from groups IIB, IVA and VB;

and those comprising:

- at least one mixed oxide formed between aluminium oxide and at least one other oxide of at least one element selected from groups IIB, IVA and VB.

4. A process according to claim 3, characterized in that the group IIB, IVA or VB element is selected from zinc, titanium, zirconium, antimony and bismuth.

5. A process according to one of claims 2 to 4, characterized in that said catalyst comprises:

- a mixture of zinc oxide and alumina or a zinc aluminate, for example of the spinel type, having the following formula:

  $ZnAl_2O_4$, x1 ZnO, y1 Al_2O_3

  x1 and y1 each being in the range 0 to 2;

- titanium oxide or a mixture of titanium oxide and alumina having the following formula:

  $(TiO_{x2})_{y2}(Al_2O_3)_{1-y2}$

  x2 having a value of 1.5 to 2.2 and y2, representing the weight ratio of the two oxides, having a value of 0.005 to 1;

- zirconium oxide or a mixture of zirconium oxide and alumina having the following formula:

  $(ZrO_{x2})_{y2}(Al_2O_3)_{1-y2}$

  x2 having a value of 1.5 to 2.2 and y2, representing the weight ratio of the two oxides, having a value of 0.005 to 1;

- a mixture of antimony oxide and alumina having the following formula:

  $(SbO_{x3})_{y3}(Al_2O_3)_{1-y3}$

  x3 having a value of 1.2 to 2.6 and y3, representing the weight ratio of the two oxides, having a value of 0.005 to 0.995;

- a mixture of zinc oxides and titanium or a mixture of zinc oxide , titanium oxide and alumina having the following formula:

  $[(ZnO)_a - (TiO_2)_b]_{y4}\ [Al_2O_3]_{1-y4}$

a having a value in the range 0.5 to 5, b having a value in the range 0.5 to 5 and y4 having a value of 0.005 to 1; or

- a mixture of oxides of bismuth and titanium or a mixture of bismuth oxide, titanium oxide and alumina having the following formula:

$[(Bi_2O_3)_a - (TiO_2)_b]_{y4}[Al_2O_3]_{1-y4}$

a having a value in the range 0.5 to 5, b having a value in the range 0.5 to 5 and y4 having a value of 0.005 to 1.

6. A process according to claim 5, characterized in that the catalyst is a zinc aluminate of the spinel type having the following formula:

$ZnAl_2O_4$, x1ZnO, y1 Al_2O_3

x1 and y1 each being in the range 0 to 2.

7. A process according to one of claims 1 to 6, characterized in that, in the transesterification step, batch reactor catalysis is carried out.

8. A process according to one of claims 1 to 6, characterized in that, in the transesterification step, continuous fixed bed catalysis is carried out.

9. A process according to claim 8, characterized in that:

- vegetable oil and methanol are introduced as an upflow into a reactor preheated to a temperature which may be in the range 170°C to 250°C at an operating temperature in the range 3 to 6 MPa, with an HSV (volume of oil/volume of catalyst/hour) of 0.3/1 to 3/1 and an alcohol/oil weight ratio of 2/1 to 0.1/1; and
- at the reactor outlet, depressurizing to at least partially eliminate the excess methanol and the glycerol formed is eliminated by simple static decantation;

the conversion of the methyl esters obtained being in the range 85% to 97%.

10. A process according to claim 9, characterized in that the reaction is continued in a second catalysis step carried out under the same operating conditions as in the first catalysis step, to achieve a methyl ester conversion of 97.5% to 99.5%.

11. A process according to one of claims 1 to 10, characterized in that the etherification step is carried out between the glycerol from the transesterification step and isobutene, in the presence of an acid catalyst.

12. A process for preparing a fuel, characterized in that it comprises:

- at least one transesterification step and an etherification step as defined in one of claims 1 to 11; and
- incorporating the glycerol acetal obtained into a fuel.

13. A process according to claim 12, characterized in that said fuel is a gas oil, a biodiesel or a gasoline.

14. A process according to claim 13, characterized in that said fuel comprises the methyl and/or ethyl ester obtained by a process according to one of claims 1 to 11.

15. A process according to one of claims 1 to 10, characterized in that the acetalization step is carried out between the glycerol obtained from the transesterification step and an aldehyde, a ketone or an acetal derived from said aldehyde or said ketone in the presence of an acid catalyst.

16. A process for preparing a fuel, characterized in that it comprises:

- at least one transesterification step and an acetalization step defined as in one of claims 1 to 10 and 15; and
- incorporating the glycerol acetal obtained into a fuel.

17. A process according to claim 16, characterized in that said fuel is a gas oil, a biodiesel or a gasoline.

18. A process according to claim 17, characterized in that said fuel comprises the methyl and/or ethyl ester obtained by a process according to one of claims 1 to 10 and 15.